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Subject: Hubble technology contributes to improved breast biopsies [Release 94-107] (Forwarded)
From: yee@atlas.arc.nasa.gov (Peter Yee)
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June 30, 1994

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HUBBLE TECHNOLOGY CONTRIBUTES TO IMPROVED BREAST BIOPSIES

A new, non-surgical and much less traumatic breast biopsy technique, based on technology developed for NASA's Hubble Space Telescope, is now saving women time, pain, scarring, radiation exposure and money, according to NASA officials.

Radiologists predict that the new technique -- known as stereotactic large-core needle biopsy -- will reduce national health care costs by approximately $1 billion annually. The new technique is replacing surgical biopsy as the technique of choice, in many cases. Performed with a needle instead of a scalpel, it leaves a small puncture wound rather than a large scar. The patient is conscious under local anesthesia compared to being unconscious in surgery.

The new technique involves a NASA-driven improvement to the digital imaging technology known as a Charge Coupled Device or CCD. CCDs are high tech silicon chips which, unlike photographic film, convert light directly into an electronic or digital image. This image can be manipulated and enhanced by computers. For the last ten years, CCDs have been almost routinely used to observe stars, galaxies, and other astronomical objects in visible and ultraviolet light.

In the breast imaging system, a special phosphor enables the new CCD to convert X-rays to visible light, allowing the

system to "see" with X-ray vision. The thinned and highly sensitive CCD -- which was not commercially available prior to Hubble's development -- is now leading the field of digital breast imaging technology, according to medical specialists.

"The woman who has gone through a needle localization procedure and formal surgical biopsy on a prior occasion and now comes in to have the same thing done, but has it done as a stereotactic biopsy, is about the most appreciative patient you can imagine, because you've taken a long, drawn-out, anxiety-ridden and expensive event and made it shorter, easier to schedule, more comfortable. She has no surgical wound," explained Dr. David Dershaw, Director of Breast Imaging at Memorial Sloan-Kettering Cancer Center in New York. (His comments are in patient information materials of the LORAD Corp., Danbury, Conn., which produces breast imaging equipment.)

The technology breakthrough came when scientists at NASA's Goddard Space Flight Center, Greenbelt, Md., developing the Space Telescope Imaging Spectrograph (STIS) -- due to be installed on Hubble in1997 -- realized that existing CCD technology could not meet the instrument's demanding scientific requirements.

NASA contracted with Scientific Imaging Technologies, Inc., (SITe), of Beaverton, Ore., to develop a more sensitive CCD and lower manufacturing costs. After meeting NASA's rigorous scientific and spaceflight requirements, the company then applied its new knowledge to manufacturing CCDs for the digital spot mammography market. The result is a device that images suspicious breast tissue more clearly and efficiently than is possible with conventional X-ray film screen technology. What made the transfer of knowledge possible was the common imaging requirements of both astronomy and mammography: high resolution to see fine details, wide dynamic range to capture in a single image structures spanning many levels of brightness, and low light sensitivity to shorten exposures and reduce X-ray dosage.

SITe's CCD for digital breast imaging is virtually identical to the CCD developed for Hubble, said William Stephens, Chief Executive Officer of SITe. Approximately 350 digital breast imaging units containing SITe's thinned CCD already are in use, said Anne Smith, Marketing and Communications Manager for the LORAD Corp., which uses the STIS-like CCDs in its breast imaging equipment, and many more are on order. Currently, digital breast imaging is most often associated with stereotactic biopsies, but by mid-1995, full digital breast units should be available for routine mammographies.

In the new non-surgical technique, the CCD is part of a

digital camera system that "sees" the suspicious breast tissue. A needle extracts the tissue. The patient lies face down with one breast protruding through an opening in a specially designed table. The imaging device and needle are mounted under the table.

The radiologist locates the suspected abnormality with the stereotactic X-ray imaging device by taking images of the suspected mass from two different angles. The computer finds the coordinates of the abnormality based on those two images, and the radiologist extracts a tiny sample of it with the needle. The tiny puncture wound is covered with a small bandage, and the patient can walk out of the office minutes after the procedure and resume normal activities.

More than 500,000 American women undergo breast biopsies each year. While 80 percent of the suspicious masses are benign, this cannot be determined without a biopsy. The traditional surgical technique involves running a guide wire into the breast to pinpoint the mass, surgically following the wire and digging into the breast to extract a tissue sample. With the traditional surgical biopsy, recuperation is about one week and involves a significant amount of pain, suturing and scarring, doctors say.

Although stereotactic location is also possible with X-ray film technique, radiologists say the new digital imaging device exposes patients to only half the radiation of the conventional X-ray film method. Unlike the X-ray film method, which radiates the entire breast, digital imaging exposes only a small portion of the breast to radiation. Also unlike X-ray film, which holds "frozen" pictures, digital images can be computer-enhanced to sharpen details. No film or plates must be processed, allowing patients to be evaluated in near real time.

"In addition to exposing patients to about half the radiation, digital breast imaging also approaches real time, cutting down procedure time by one-half to one-third," said Dr. Dershaw. "It's more cost effective."

Studies show that the new procedure is just as effective as traditional surgery. While traditional surgery costs about $3,500, core biopsy runs about $850. Sampling suspicious tissue now can be done in a radiologist's office.

The digital images, which are stored on computer disks, may be downloaded instantly to distant experts via computer networks, cellular signals or satellites, Stephens said. The digital image acquisition is almost foolproof, he explained, virtually eliminating re-takes and additional radiation exposure.

"The image quality is much better because the signal-to-

noise ratio is better with CCDs," explained Dr. Hans Roehrig, Research Professor of Radiology and Optical Science at the University of Arizona. "You don't get the granularity that you do with X-ray film, which causes the signal-to-noise ratio of the film to be poor."

"Stereotactic biopsies also were done before the advent of the thinned CCDs, but they took a long time," said Dr. Roehrig. "First, two X-ray pictures of the abnormality had to be taken. The pictures had to be developed in the darkroom, which takes about three minutes. Then, measurements had to be taken on the film images and run through a computer in order to perform triangulation to determine the coordinates [of the suspected abnormality]. The process of taking pictures, developing the film and locating the coordinates of the abnormal tissue mass typically takes about fifteen to twenty minutes, and during this whole time, the patient -- still at the machine -- cannot move. Now, in near real time, the entire process of locating the mass can take as little as five minutes and is much more comfortable for the patient."

The new biopsy technique, made possible by the CCDs developed for Hubble Space Telescope, will spare millions of women pain, scars and radiation exposure, will lead to much faster recuperation and will save billions in health care costs.

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NOTE TO EDITORS: Color and B&W images are available to news media from NASA's Broadcast and Imaging Branch. To obtain images, please fax your request to the Branch at 202/358-4333. The photo numbers for the color images are 94-HC-168 and 94-HC-169; and for the B&W images, the numbers are 94-H-180 and 94-H-183.